APPENDIX B - MARKED-UP SPECIFICATION

Please amend the paragraph beginning page 1, line 5 and ending page 2, line 4, as follows:

---The present invention relates to an apparatus and a method for statistically multiplexing channels [by] using an orthogonal code hopping in a wire/wireless communications system where a plurality of the channels synchronized through one media and having a low data activity coexist. More particularly, the present invention relates to an apparatus and a method in which, in a system having a first communication station and a plurality of second communication stations synchronized with the first communication station, the first communication station recognizes a channel toward each second communication station with an orthogonal code hopping pattern, the orthogonal code hopping pattern of the second communication stations is determined at random, orthogonal code symbols in the hopping patterns of different channels may coincide at an instance (hereinafter, the above coincidence of the orthogonal code symbols is referred to as "hopping pattern collision"), the system inspects send data symbols for all send channels of the first communication station related with the collision and makes a corresponding data symbol interval OFF if any channel sends a data symbol not coincident with other channels, and transmission power of all channels where transmission of the data symbol is OFF as much

as an amount and during an interval defined in a communication protocol in order to supplement average bit energy of loss data in all relevant channels.---

Please amend the paragraph on page 2, beginning line 7 and ending line 11, as follows:

---Descriptions in this application are based on a wireless [communication] communications system, however the statistical multiplexing suggested in the application may be applied to a [wire] wired communications system as well as the [wire] wireless communications system without any change.---

Please amend the paragraph on page 2, beginning line 12 and ending line 15, as follows:

---In order to point out clearly which parts or concepts are developed or improved in the present invention in comparison with the prior art, a prior art is described on the basis of [a communication] communications system IS-95, which is already in service.---

Please amend the paragraph beginning page 2, line 16 and ending page 3, line 10, as follows:

---[The] A first communication station and [the] a second communication station in this application [are corresponding] correspond to a base station and a mobile station in a conventional system. One first communication station communicates with a plurality of second communication stations and the present invention suggests a statistical multiplexing,

which may be applied to a synchronized channel group having an orthogonality from the first communication station toward the second communication stations. For a system, which maintains the orthogonality only for each channel group, such as Quasi-Orthogonal Code (QOC) adapted to Code Division Multiplexing Access (CDMA) 2000, which is one [of] candidate [techniques] technique for [the] a next generation mobile communications system, referred herein as "the IMT-2000 (International Mobile Telecommunications-2000)", the present invention may be independently implemented for each channel group. Moreover, when classifying channels of the first communication station such as sectored or smart antenna systems into channel groups having the same send antenna beam, the present invention may be independently implemented in each channel group.---

Please amend the paragraph on page 3, beginning line 11 and ending line 19, as follows:

---In the [communications method by] OCDM (Orthogonal Code Division Multiplexing) communications method adapted by the conventional IS-95 system, the first communication station allocates orthogonal code symbols, which [has] have not been allocated among the orthogonal codes when establishing a call, to one of the second communication stations and the second communication station gives back the allocated orthogonal code symbols to the first communication station when releasing the call, such that other second communication stations may use the orthogonal code symbols.---

Please amend the paragraph on page 5, beginning line 8 and ending line 16, as follows:

---A paging channel 220 is a common channel used in case of an incoming message to the second communication station or for answering [to] a request of the second communication station. A lot of [the] paging channels 220 can exist. The data transmitted to the paging channel [pass] <u>passes</u> through a convolutional encoder 224, a symbol repeater 226 and a block interleaver 228 and passes through an exclusive OR gate 236 together with an output of a long code generator 232 generated by a long code mask 230. The data through the exclusive OR gate 236 is then transmitted to the spreading and modulating unit of FIG. 3.---

Please amend the paragraph beginning page 5, line 17 and ending page 6, line 22, as follows:

---A traffic channel 240 in FIG. 2b is a channel dedicatedly allocated to each second communication station for use until the call is completed. When there are data to be transmitted to each second communication station, the first communication station transmits the data through the traffic channel 240. The data from the traffic channel 240 passes through a cyclic redundancy check (CRC) 241 for inspecting an error in a specific time unit, or frame, (e.g. 20ms in IS-95). Tail bits 242 are inserted into the traffic channel, all of which are "0", and the data through the CRC 241 [pass] <u>passes</u> through a convolutional encoder 244

[for ensuring to independently encoding] to ensure the independent encoding of the channel in a frame unit. The data then [pass] passes through a symbol repeater 246 [for matching] to match the transmission data symbol rate according to a send data rate. After passing through the symbol repeater 246, the data [pass] passes through a block interleaver 248 [for changing] to change an error burst into a random error. The data passing through the block interleaver 248 are scrambled in a scrambler 256 with use of a pseudo-noise (PN) sequence, generated by passing an output of a long code generator 232 decimated in a decimator 234 with the use of a long code mask 250 generated by an electronic serial number (ESN) allocated to each second communication station. A PCB (page control block) position extractor 258 extracts a position where a command for controlling transmission power from the second communication station is inserted in the PN sequence decimated in the decimator 234. A punch and insert 260 punches a data symbol corresponding to the insert position of the power control command extracted by the PCB position retractor 258 among the data symbols scrambled in the scrambler 256 and inserts the power control command, [then transmitting] and then transmits the power control command to the spreading and modulating unit shown in [FIG. 3] FIGS. 3a-3c.---

Please amend the paragraph on page 7, beginning line 3 and ending line 7, as follows:

---FIG. 3a corresponds to the commonly used IS-95 method employing BPSK (Binary Phase Shift Keying) as a data modulating method. FIG. 3b shows the spreading and

modulating unit employing QPSK (Quadrature Phase Shift Keying) as a data modulating method for transmitting double data in comparison with the method in FIG. 3a.---

Please amend the paragraph on beginning page 7, line 8 and ending page 8, line 4, as follows:

---FIG. 3b [is adapted] illustrates the CDMA 2000 method, which is [one of candidate techniques] a candidate technique for the IMT-2000. FIG. 3c shows a spreading and modulating unit, which employs QOC (Quasi-Orthogonal Code) used in CDMA 2000, which is [one of candidate techniques] also a candidate technique for the IMT-2000. In FIG. 3, signal converters 310, 326, 330, 346, 364 convert logic signals "0" and "1" into physical [signal] signals "+1" and "-1" to be [really] transmitted. Each channel of FIG. 2 passes through the signal converters and is then spread in spreaders 312, 332 by an output of a Walsh code generator 362. Transmission power of each channel is adjusted in amplifiers 314, 334. All channels of the first communication station are spread in spreaders 314, 334 by an orthogonal Walsh function of the Walsh code generator 362 fixedly allocated to each channel [fixedly]. The channels are then amplified in the amplifiers 314, 334 and then pass through QPSK spreading and modulating units 318, 338. Signals spread and modulated in the QPSK spreading and modulating units 318, 338 are multiplied by a carrier in multipliers 322, 342 to [transit] transmit to a sending band through low-pass filters (LPF) 320, 340. The

signal multiplied by the carrier passes through a radio communication unit and is then transmitted through an antenna, not shown in the figures.---

Please amend the paragraph on page 8, beginning line 5 and ending line 10, as follows:

---FIG. 3b is identical to FIG. 3a except [the fact] that, in order to transmit the signal generated in FIG. 2 to QPSK instead of BPSK, different information data are carried in an in-phase channel and a quadrature phase channel through a demultiplexer 390. Using the demultiplexer 390 and the signal converters 310, 330 enables QAM (Quadrature Amplitude Modulation) as well as QPSK.---

Please amend the paragraph beginning page 8, line 18 and ending page 9, line 6, as follows:

---FIGs. 4a, 4b and 4c [shows] <u>show</u> signals used in the code division multiplexing, which spreads the signal generated in FIG. 2 and FIG. 3 into the orthogonal code symbol fixedly allocated to each channel, according to the prior art. A pilot channel 410 is spread by a fixedly allocated orthogonal Walsh code symbol W#0 in a spreader 412. Other channels are also spread by orthogonal Walsh code symbols W#1, W#2, ... W#29, W#30, ... W#63 fixedly allocated regardless of activities of the corresponding channels. If allocating the orthogonal code symbol fixedly to a channel such as channels 440, 450, 460 having relatively

low transmission data activity, utilization of the orthogonal code, which is a limited source, is much less than 100%.---

Please amend the paragraph on page 11, beginning line 1 and ending line 20, as follows:

---FIG. 7 shows a configuration of a receiver to which a control command [for controlling] controls a transmission power from the second communication station to the first communication station like the traffic channel. As shown in the figure, the signal enduring the phase compensation in FIG. 5 passes through maximum ratio combiners 710, 712. In the case that a receiver performs a QPSK data modulation as shown in FIG. 5, a multiplexer 714 [multiplex a] multiplexes an in-phase component and an orthogonal phase component in the signal. An extractor 740 extracts a signal component corresponding to the power control command transmitted from the first communication station among the received signal. The signal from the extractor 740 then passes through a hard decision unit 744 and is then transmitted to a transmission power controller of the second communication station. Data symbols, except the power control command in the received signal from the multiplexer 714, pass through a soft decision unit 742. A decimator 724 decimates an output of a long code generator 722 generated by a long code mask 720 generated by an identifier of the second communication station. The data symbols from the soft decision unit 742 [is] are then

multiplied in a multiplier 718 by a result of the decimator 724, so as to perform descrambling.---

Please amend the paragraph beginning page 11, line 21 and ending page 12, line 12, as follows:

---FIG. 8 shows a function of recovering the received signal through the signal processes of FIG. 6 and FIG. 7 from the first communication station, through block deinterleavers 818, 828, 838 and convolutional decoders 814, 824, 834. In a synchronous channel 810, in order to lower a symbol rate, a sampler 819 performs a symbol compression for the signals through the soft decision unit by accumulating the signals, which is an inverse process to the symbol repeater 219. The signal through the sampler 819 passes through a block interleaver 818. Then, a sampler 816 performs the symbol compression again for the signal, which is an inverse process to the symbol repeater 216, before the signal passes to a convolutional decoder 814. The signal [passing] enduring the symbol compression then passes through the convolutional decoder 814, [then] recovering the synchronous channel transmitted from the first communication station.---

Please amend the paragraph on page 12, beginning line 13 and ending line 20, as follows:

---In the case of a paging channel 820, the signal enduring the soft decision passes through a block deinterleaver 828 for channel interleaving. The signal enduring the channel

interleaving passes through a sampler 826 for symbol compression according to the send data rate, which is an inverse process of the symbol repeater 226. The signal enduring the symbol compression passes through a convolution decoder 824 for channel decoding, [so] recovering the paging channel transmitted from the first communication station.---

Please amend the paragraph beginning page 12, line 21 and ending page 13, line 18, as follows:

---In <u>the</u> case of a traffic channel 830, the signal enduring the soft decision passes through a block deinterleaver 838 for performing channel deinterleaving regardless of a send data rate. The signal enduring the channel interleaving passes through a sampler 836 for performing symbol compression according to the send data rate, which is an inverse process to the symbol repeater 246. A convolutional decoder 834 performs <u>a</u> channel decoding for the signal enduring the symbol compression. A tail bit remover 832 removes tail bits of the signal used for <u>the</u> [independent send signal generation] <u>independently send signal generated</u> in a frame unit. A CRC 831 generates a CRC bit for the send data portion like the transmitter and inspects errors by comparison with a recovered CRC after channel decoding. If the two CRC bits [coincides] <u>coincide</u>, the CRC 831 determines that there is no error<u>,</u> and then<u>,</u> the traffic channel data [are] <u>is</u> recovered. If the transmitter does not include information about the send data rate in 20ms frame unit, the send data rate of the first communication station may be determined by channel-decoding the signals enduring the independent channel

deinterleaving and comparing the CRC bits. A system, which transmits a send data rate independently, just further requires a channel decoding process corresponding to the data rate.---

Please amend the paragraph beginning page 13, line 19 and ending page 14, line 19, as follows:

---In case of spreading the despreading data symbol by fixedly using the orthogonal code allocated when establishing a call as shown in FIG. 3 in order to maintain orthogonality between channels from the first communication station to the second communication station as shown in FIG. 1, the orthogonal code, limited source, may not be efficiently used for [send] sending data having a relatively low activity, such as data indicated by reference numbers 440, 450 and 460 in FIG. 4a. In order to increase the activity of the orthogonal code with fixed allocation, rapid channel allocation and return are required. However, if transmitting the control signal information for channel allocation and return more frequently, more significant amounts of limited frequency resources should be used for the control information of the data transmission, not for the data transmission itself. Moreover, however rapid the channel allocation and return are processed, there should be a buffering process after the data to be transmitted reaches [at] the first communication station [till] until transmitted in order to transmit a channel allocation (or return) message and respond to the message. As the time for such processes is extended, more capacity is required in the buffer.

Information, which requires checking whether the information is transmitted normally, should be buffered for retransmission. However, in <u>the</u> case of transmitting information without checking normal transmission of the information, such as, in a datagram method, a delay should be minimized in an allowable range in order to decrease the capacity of the buffer.---

Please amend the paragraph beginning page 14, line 20 and ending page 15, line 5, as follows:

---Therefore, while the prior art allocates the orthogonal codes in a fixed manner so <u>as</u> to have <u>a</u> 1:1 relation between the orthogonal code and the channel, the present invention, with a little modification of the prior art, performs statistical multiplexing for traffic channels having low activities in consideration of activity of the [send] <u>sent</u> data in order to increase <u>the</u> activities of the orthogonal codes, which are limited resources, and [eliminates] <u>to eliminate</u> unnecessary channel allocating and returning processes in order to decrease <u>the</u> buffer capacity and data transmission delay.---

Please amend the paragraph on page 15, beginning line 8 and ending line 19, as follows:

---The present invention is designed to overcome the above problems of the prior art. An object of the invention is to decrease <u>the</u> waste of resources caused by <u>the</u> transmission of unnecessary control signals, minimize a required capacity of a buffer in a first

communication station used for time division multiplexing and reduce a data transmission delay by means of efficiently utilizing the limited resources [efficiently] with the use of a statistical multiplexing method, namely orthogonal code hopping multiplexing, when synchronized channels maintaining orthogonality have low activities, and performing spreading or despreading according to a hopping pattern of each transmitter and receiver by skipping unnecessary channel allocating and returning processes.---

Please amend the paragraph on page 17, beginning line 5 and ending line 8, as follows:

---The transmission power control command of each second communication station in the common power control channel can be time-multiplexed and may employ a collision-resistant hopping pattern to prevent [for preventing] collision of the hopping pattern.---

Please amend the paragraph on page 19, beginning line 3 and ending line 7, as follows:

---Preferably, the hopping pattern collision is prevented only when there is a possibility that sending antenna beams of the first communication station, where the hopping patterns are collided, are superposed so as to cause a serious error in a channel decoding process of the second communication station.---

Please amend the paragraph on page 20, beginning line 6 and ending line 12, as follows:

---The orthogonal code collision detector may include a despreading data symbol comparator for [comparing] determining that all [of] despreading data symbols of corresponding channels are the same at the time of a hopping pattern collision; and the interrupter may interrupt transmission of the sending signal in case that the corresponding despreading data symbols are not same as a comparison result of the despreading data symbol separator.---

Please amend the paragraph beginning page 22, line 8 and ending page 26, line 4, as follows:

---These and other features, aspects, and advantages of preferred embodiments of the present invention will be more fully described in the following detailed description, [taken] and accompanying drawings. In the drawings:

FIG. 1 shows a concept of a system having a first communication station and second communication [stations] station according to both the prior art and the present invention;

FIG. 2a shows a configuration of a transmitter in the first communication station, which is a common component of the prior art and the present invention;

FIG. 2b shows a configuration of a transmitter for traffic channels in the first communication station according to the prior art;

FIG. 3a shows a configuration of a receiver in the first communication station using a CDMA method in case of BPSK data modulation according to the prior art;

FIG. 3b shows a configuration of a receiver in the first communication station using a CDMA method in case of QPSK data modulation according to the prior art;

FIG. 3c shows a configuration of a receiver in the first communication station using a CDMA method in case of using QOC data according to the prior art;

FIG. 4a shows a send signal of the first communication station according to the prior art;

FIG. 4b shows an orthogonal code for distinguishing channels according to the prior art;

FIG. 4c shows the CDMA according to the prior art;

FIG. 5 shows a configuration of a receiver in the second communication station in the CDMA method according to the prior art;

FIG. 6 shows a configuration of common components of the receiver in the second communication station according to the prior art and the present invention;

FIG. 7 shows a configuration of the receiver in the second communication station in FIG. 4b;

FIG. 8 shows a configuration of common components of the receiver according to the prior art and the present invention;

FIG. 9 shows a configuration of a transmitter in the first communication station about traffic channels for orthogonal code hopping multiplexing and a configuration of a common power control channel for the traffic channels;

FIG. 10a shows a configuration of a transmitter in the first communication station using the orthogonal code hopping multiplexing according to the present invention, corresponding to FIG. 4a;

FIG. 10b shows a configuration of a transmitter in the first communication station using the orthogonal code hopping multiplexing according to the present invention, corresponding to FIG. 4b;

FIG. 10c shows a configuration of a transmitter in the first communication station using the orthogonal code hopping multiplexing according to the present invention, corresponding to FIG. 4c;

FIG. 11 shows a configuration of an orthogonal code hopping pattern generator according to the present invention;

FIG. 12a shows an example of an orthogonal variable spreading factor code according to the present invention;

FIG. 12b shows an orthogonal gold code generator according to the present invention;

FIG. 13 shows a configuration of a receiver in the second communication station in the orthogonal code hopping multiplexing of FIG. 10b according to the present invention;

FIG. 14a shows a send signal when using the code division multiplexing for traffics toward the second communication station having relatively high send data activities;

FIG. 14b shows a send signal when using the orthogonal code hopping multiplexing for traffics toward the second communication station having relatively low send data activities;

FIG. 14c shows the orthogonal spreading code of the present invention;

FIG. 14d shows the code division multiplexing of FIG. 14a according to the present invention;

FIG. 14e shows the statistical multiplexing by the orthogonal code hopping multiplexing of FIG. 14b according to the present invention;

FIG. 14f shows hopping pattern collisions in case of the orthogonal code hopping multiplexing of FIG. 14b according to the present invention;

FIG. 14g shows transmission stopping in the collision area of relevant channels when the hopping patterns collide and send data symbols do not match as shown in FIG. 14f;

FIG. 14h shows the process of increasing transmission power of the first communication station in a certain area after a data symbol not transmitted in order to compensate average receiving energy required for a channel decoder for satisfied communication quality when stopping transmission in the hopping pattern collision area in FIG. 14g; and

FIG. 15 is a diagram for illustrating that transmission stopping caused by the hopping pattern collision and mismatch of the send data symbols is independently operated for each send antenna beam of the first communication station.---

Please amend the paragraph on page 26, beginning line 14 and ending line 21, as follows:

---FIG. 9 is a modified one of the traffic channel of the prior art for performing orthogonal code hopping multiplexing in the case of having a low send data activity, which is identical to the prior art except that a transmission power control command for the second communication station is inserted. Communication is divided into a bi-directional communication and a one-directional communication, in which the one-directional communication does not need the transmission power control command for the second communication station.---

Please amend the paragraph beginning page 26, line 22 and ending page 27, line 16, as follows:

---However, in the case of the bi-directional communication, the transmission power control command is required in order to maximize the system capacity through effective power control. For improving a processing rate, the power control command does not endure channel coding in most cases. A random orthogonal code hopping pattern inevitably causes collisions between each other channels. Therefore, it is required to transmit the power

control command to a channel in which a collision is generated. In this point, a concept of a common power control channel adapted in CDMA 2000, which is one [of] candidate [techniques] technique for the IMT-2000, may be introduced. The common power control channel is spread by a separate orthogonal code symbol, such as the pilot channel, and transmitted by the same division multiplexing for a plurality of the second communication stations. A position of the power control command for each second communication station is allocated in a call establishing process. FIG. 9 shows an embodiment of the common power control channel for controlling 24 second communication stations.---

Please amend the paragraph beginning page 27, line 17 and ending page 28, line 13, as follows:

---FIGs. 10a, 10b and 10c show embodiments to which characteristics of the present invention are applied to the prior art shown in FIGs. 3a, 3b and 3c. For statistical multiplexing by the orthogonal code hopping multiplexing suggested in the present invention, [required are] an orthogonal code hopping pattern generator 380 and collision comparator [&] and controller 384, 386 for suitable control by detecting collisions of the orthogonal code symbols generated by the random hopping pattern generation are required. An example of the orthogonal code hopping pattern generator is shown in FIG. 11, which has a configuration for generating the hopping pattern with use of a general PN sequence generator. [There is required an] An orthogonal code generator 382 is required for

generating a spreading orthogonal code symbol according to the hopping pattern generator 380. The orthogonal code generated in the orthogonal code generator 382 may be an orthogonal variable spreading factor (OVSF) having a hierarchical structure which can be a Walsh code for a specific spreading factor as shown in FIG. 12a, or an orthogonal gold code generated by an orthogonal gold code generator as shown in FIG. 12b. Any orthogonal code maintaining orthogonality is possible.---

Please amend the paragraph beginning page 28, line 14 and ending page 29, line 1, as follows:

---When an output of the orthogonal code hopping pattern generator 380 is constant, [the present invention equals to] the orthogonal code division multiplexing [identical to] is the same as with the prior art. That is, the orthogonal code division multiplexing of the prior art is a subset of the orthogonal code hopping multiplexing of the present invention. Therefore, after dividing one orthogonal code into two orthogonal code symbol groups, one orthogonal code group is used for an orthogonal code hopping multiplexing using a fixed allocation and the other orthogonal code group is used for an orthogonal code hopping multiplexing using a hopping pattern.

Please amend the paragraph beginning page 30, line 22 and ending page 31, line 9, as follows:

---In order to compensate for the deficiency of an average receiving energy in the second communication station due to a transmission stop of the despreading data symbol for satisfied quality, a gain of amplifiers 315, 335 of the corresponding channel is adjusted as much as a size given by a system parameter during an area given by a system parameter like the reference numbers 1072, 1074 in FIG. 14h, then increasing the transmission power of the first communication station. Regardless of the above process, the transmission power control for the first communication station is performed according to the method of the prior art.---

Please amend the paragraph on page 34, beginning line 2 and ending line 7, as follows:

---Such channel stop is carried out for the channel group existing in the same send antenna beam from the first communication station. In case [that] a plurality of send antenna beams 1120, 1130, 1140 from the first communication station, such as a smart antenna exist, the transmission is not stopped for channels 1132, 1142, 1144 in non-overlapped send antenna beams 1130, 1140 though the hopping patterns collide.---

Please amend the paragraph on page 34, beginning line 15 and ending line 22, as follows:

---As described in the embodiments of the present invention, if [performing] the orthogonal code hopping multiplexing is performed with random hopping patterns, the send data may be [intentionally] lost in an area where the hopping patterns collide. Therefore, in

order to recover the lost data [existing in the loss area in the receiver], it is essential that the transmitter performs the channel encoding and the receiver performs the channel decoding.---

Please amend the paragraph beginning page 34, line 22 and ending page 35, line 3, as follows:

---The statistical multiplexing of the present invention may be used in combination with other multiplexing methods, such as, for example, a time division multiplexing, a frequency division multiplexing, a space division multiplexing, etc.---

Please amend the paragraph on page 36, beginning line 2 and ending line 17, as follows:

---Moreover, the present invention may distinguish a nearly unlimited number of channels (if the hopping pattern has a period in a frame unit, near $64^{19.2\text{kspsx20ms}} = 64^{384}$ [of] channels on the basis of the IS-95 system) when selecting the hopping patterns at random in comparison to the method of allocating the spreading orthogonal code symbols fixedly. Furthermore, [though there occurs] although a collision may occur between the spreading orthogonal code symbols due to the random selection of the hopping patterns, there is no need to stop transmission of the colliding despreading data symbol in the case [that] where the second communication station exists in an area where send antenna beams [of], such as, a sectored antenna and a smart antenna are not overlapped. In addition, the data symbols, which [is] are not transmitted due to the hopping pattern collision between channels in the

same send antenna beam, may be recovered in the channel decoding process of the second communication station without informing [to] the second communication station.---